This document includes Appendix A: Bilgewater Engineering and Modeling Recommendations Summary Formulas for Calculations, of the Draft EPA Report “Surface Vessel Bilgewater/Oil Water Separator Characterization Analysis Report” published in August 2003. The reference number is: EPA-842-D-06-017

DRAFT
Characterization Analysis Report
Surface Vessel Bilgewater/Oil Water Separator

Appendix A: Bilgewater Engineering and Modeling Recommendations Summary Formulas for Calculations

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APPENDIX A—Bilgewater Engineering and Modeling Recommendation Summary Formulas for Calculations

Duration of Single Release Event Pierside:

Variables:

1. Oily Waste Holding Tank (OWHT) capacity (gallons)
2. Pierside generation rate (gal/day)
3. OWS processing rate (gal/min)

Simplifying assumptions:

1. A net processing rate should be used to determine the release period because bilgewater is generated as it is being processed through the MPCD or as it is being sent around it (baseline).
2. Based upon Navy practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 90% capacity.
3. Based upon USCG practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 70% capacity.
4. The MPCD operates at its rated capacity.

Net Processing Rate:

Net Processing Rate (gal/min) = OWS processing rate (gal/min) – [pierside generation rate (gal/day) * (1 day/24 hours) * (1 hour/60 min)]

Release Period for Navy Vessels:

Release Period $_{Navy}$ (hrs) = [.90 * OWHT capacity (gallons)] / [Net Processing Rate (gal/min) * (60 min/hr)]

Release Period for Coast Guard Vessels:

Release Period $_{USCG}$ (hrs) = [.70 * OWHT capacity (gallons)] / [Net Processing Rate (gal/min) * (60 min/hr)]

Duration of Single Release Event Underway:

Variables:

1. Oily Waste Holding Tank (OWHT) capacity (gallons)
2. Underway generation rate (gal/day)
3. OWS processing rate (gal/min)

Simplifying assumptions:

1. A net processing rate should be used to determine the release period because bilgewater is generated as it is being processed through the MPCD or as it is being sent around it (baseline).
2. Based upon Navy practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 90% capacity.
3. Based upon USCG practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 70% capacity.
4. The MPCD operates at its rated capacity.

Net Processing Rate:

Net Processing Rate (gal/min) = OWS processing rate (gal/min) – [underway generation rate (gal/day) * (1 day/24 hours) * (1 hour/60 min)]

Release Period for Navy Vessels:

Release Period $_{Navy}$ (hrs) = [.90 * OWHT capacity (gallons)] / [Net Processing Rate (gal/min) * (60 min/hr)]

Release Period for Coast Guard Vessels:

Release Period $_{USCG}$ (hrs) = [.70 * OWHT capacity (gallons)] / [Net Processing Rate (gal/min) * (60 min/hr)]

Time Between Release Events Pierside (Except WHEC 378 Class):

Variables:
1. Oily Waste Holding Tank (OWHT) capacity (gallons)
2. Pierside generation rate (gal/day)

Simplifying assumptions:
1. Bilgewater accumulates in the OWHT at a rate equal to the pierside generation rate until that point in time whereby the MPCD begins to process bilgewater effluent overboard.
2. Based upon Navy practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 90% capacity.
3. Based upon USCG practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 70% capacity.

Non-release Period for Navy Vessels:

Non-release Period $_{Navy}$ (hrs) = .90 * OWHT capacity (gallons) / [pierside generation rate (gal/day) * (1 day/24 hours)]

Non-release Period for Coast Guard Vessels:

Non-release Period $_{USCG}$ (hrs) = .70 * OWHT capacity (gallons) / [pierside generation rate (gal/day) * (1 day/24 hours)]

Time Between Release Events Underway (Except WHEC 378 Class):

Variables:
1. Oily Waste Holding Tank (OWHT) capacity (gallons)
2. Underway generation rate (gal/day)

Simplifying assumptions:
1. Bilgewater accumulates in the OWHT at a rate equal to the underway generation rate until that point in time whereby the MPCD begins to process bilgewater effluent overboard.
2. Based upon Navy practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 90% capacity.
3. Based upon USCG practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 70% capacity.

Non-release Period for Navy Vessels:

Non-release Period $_{Navy}$ (hrs) = .90 * OWHT capacity (gallons) / [pierside generation rate (gal/day) * (1 day/24 hours)]

Non-release Period for Coast Guard Vessels:

Non-release Period $_{USCG}$ (hrs) = .70 * OWHT capacity (gallons) / [pierside generation rate (gal/day) * (1 day/24 hours)]

Time Between Release Events (WHEC 378 Class):

Variables:
1. Oily Waste Holding Tank (OWHT) capacity (gallons)
2. Pierside generation rate (gal/day)
3. Underway generation rate (gal/day)
4. Time within 12 nm (days)
5. Time outside 12 nm (days)
6. Time pierside (days)

Simplifying assumptions:
1. Bilgewater accumulates in the OWHT until that point in time whereby the MPCD begins to process bilgewater effluent overboard.
2. Based upon USCG practices, the MPCD is assumed to begin processing bilgewater when the OWHT reaches 70% capacity.

Time underway = Time within 12 nm + Time outside 12 nm

Average daily generation rate (gal/day) = [Time underway/(Time pierside +Time underway) * Underway generation rate] + [Time pierside/(Time pierside +Time underway) * Pierside generation rate]

Non-release Period for WHEC 378 Class Vessels:

Non-release Period $_{\text{WHEC 378 Class Vessel}}$ (hrs) = .70 * OWHT capacity (gallons) / [average daily generation rate (gal/day) * (1 day/24 hours)]

Temperature of Discharge

The temperature of bilgewater is dependent on several factors. Bilgewater on a DDG 51 Class vessel is temporarily held in the ship's bilge prior to being transferred an OWHT. Because both of these areas are separated from the water body only by the ship's hull, bilgewater is often at or near the ambient water temperature. Ambient air temperature inside the machinery space and the temperature of the source bilgewater can also have an effect on bilgewater temperature. Bilgewater is not used as a cooling or heating fluid. Therefore, for modeling purposes, bilgewater is assumed to be at the temperature of the receiving water.

Salinity of Discharge:

Baseline and gravity coalescer effluent were sampled for each vessel class. An average of the sampling data was used to determine one representative salinity value for each vessel class. Salinity values for the other MPCD options are assumed to be similar to sampled results and thus the average value described above was used for these options as well.

Exit Velocity of Discharge:

Variables:

1. OWS processing rate (gal/min) = Flow
2. Diameter (d) of discharge port (inches) = 2 * Radius (r)

Simplifying assumptions:

1. The MPCD operates at its rated capacity.
2. Flow of exit discharge is equal to the processing rate of the MPCD or the flow of the baseline discharge.

Exit Velocity:

Velocity = Flow/Area = Flow/$\pi * r^2$ = Flow/$[\pi * (1/2 * d)^2]$

Velocity (ft/sec) = [OWS processing rate (gal/min) * (.223 (ft^3/sec)/100 (gallons/min))] / $[\pi * (1/2 * \text{diameter (in)})^2 * (1\ ft^2/144\ in^2)]$